

Attachment H

COVER SHEET (PAGE 1 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Proposal Title: Genetic comparison of stocks considered for re-establishing steelhead *Oncorhynchus mykiss* in Clear Creek, a tributary to the Upper Sacramento River.

Applicant Name: U.S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office.

Mailing Address: 10950 Tyler Road, Red Bluff, CA 96080

Telephone: (530)527-3043
Fax (530)529-0292

Amount of funding requested: \$45,493 for the complete study design, \$34,195 for the alternate (minimum) study design.

Indicate the Topic for which you are applying (check only one box). Note that this is an important decision: see page 8 of the Proposal Solicitation Package for more information

- | | |
|---|--|
| <input type="checkbox"/> Fish Passage Assessment | <input type="checkbox"/> Fish Passage Improvements |
| <input type="checkbox"/> Floodplain and Habitat Restoration | <input type="checkbox"/> Gravel Restoration |
| <input type="checkbox"/> Fish harvest | <input checked="" type="checkbox"/> Species Life History Studies |
| <input type="checkbox"/> Watershed Planning/Implementation | <input type="checkbox"/> Education |
| <input type="checkbox"/> Fish Screen Evaluations - Alternatives and Biological Priorities | |

Indicate the geographic area of your proposal (check only one box):

- | | |
|---|--|
| <input type="checkbox"/> Sacramento River Mainstem | <input checked="" type="checkbox"/> Sacramento Tributary: <u>Clear Creek</u> |
| <input type="checkbox"/> Delta | <input type="checkbox"/> East Side Delta Tributary: _____ |
| <input type="checkbox"/> Suisun Marsh and Bay | <input type="checkbox"/> San Joaquin Tributary: _____ |
| <input type="checkbox"/> San Joaquin River Mainstem | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> landscape (entire Bay-delta watershed) | <input type="checkbox"/> North Bay: _____ |

Indicate the primary species which the proposal addresses (check no more than two boxes):

- | | |
|--|---|
| <input type="checkbox"/> San Joaquin and East-side Delta tributaries fall-run chinook salmon | <input type="checkbox"/> Spring-run chinook salmon |
| <input type="checkbox"/> Winter-run chinook salmon | <input type="checkbox"/> Fall-run chinook salmon |
| <input type="checkbox"/> Late-fall run chinook salmon | <input type="checkbox"/> Longfin smelt |
| <input type="checkbox"/> Delta smelt | <input checked="" type="checkbox"/> Steelhead trout |
| <input type="checkbox"/> Splittail | <input type="checkbox"/> Striped bass |
| <input type="checkbox"/> Green sturgeon | |
| <input type="checkbox"/> Migratory birds | |

COVER SHEET (PAGE 2 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Indicate the type of applicant (check only one box):

- | | |
|--|--|
| <input type="checkbox"/> State agency | <input checked="" type="checkbox"/> Federal agency |
| <input type="checkbox"/> Public/Non-profit joint venture | <input type="checkbox"/> Non-profit |
| <input type="checkbox"/> Local government/district | <input type="checkbox"/> Private party |
| <input type="checkbox"/> University | <input type="checkbox"/> Other: _____ |

Indicate the type of project (check only one box):

- | | |
|--|---|
| <input type="checkbox"/> Planning | <input type="checkbox"/> Implementation |
| <input type="checkbox"/> Monitoring | <input type="checkbox"/> Education |
| <input checked="" type="checkbox"/> Research | |

By signing below, the applicant declares the following:

- (1) the truthfulness of all representations in their proposal;
- (2) the individual signing the form is entitled to submit the application on behalf of the applicant (if applicant is an entity or organization); and
- (3) the person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section II.K) and waives and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.



(Signature of Applicant)

II. EXECUTIVE SUMMARY

a. *Project Title*

Genetic comparison of stocks considered for re-establishing steelhead *Oncorhynchus mykiss* in Clear Creek, a tributary to the Upper Sacramento River.

Applicant Name

U.S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office
10950 Tyler Road, Red Bluff, California 96080

Phone: (530)527-3043, FAX: (530)529-0292, E-mail: JIM_SMITH@MAIL.FWS.GOV

Principle investigators: Kevin Niemela and Matt Brown

b. *Project Description and Primary Biological/Ecological Objectives*

The goal of this project is to obtain fine-scale information on genetic diversity of several stocks of steelhead/rainbow trout *Oncorhynchus mykiss* from Coleman National Fish Hatchery; the mainstem Upper Sacramento River; and Mill, Deer, and Clear Creeks, three tributaries to the Upper Sacramento River. Information gathered will be used primarily to determine the preferred source (most similar to native Clear Creek steelhead) of a founding stock for re-establishing a self-sustaining steelhead population in Clear Creek following the removal of McCormick-Saeltzer Dam in 1999. Results of this research will be used to facilitate re-establishment of a steelhead run in Clear Creek, while at the same time maintaining or improving the genetic integrity of the Upper Sacramento River population. Methods considered for re-establishing a steelhead population in Clear Creek are: 1) allowing strays from the Upper Sacramento River to repopulate; 2) stocking steelhead (juveniles or returning adults) from Coleman NFH; and, 3) trans-locating offspring of "native" resident rainbow trout from isolated, residualized populations in upper Clear Creek, above Whiskeytown Dam. The proposed study will provide information to determine the most appropriate method of steelhead reintroduction, and will also provide: 1) information regarding the utility of the Coleman NFH steelhead for this and subsequent re-introduction efforts; and, 2) information regarding temporal stability of allele frequencies in steelhead from tributaries to the Upper Sacramento River.

c. *Approach/Tasks/Schedule*

Field work for this project will begin with collection of tissue samples from steelhead adults returning to Coleman National Fish Hatchery in January, 1999. Tissues will be collected from naturally spawning steelhead/rainbow trout adults and juveniles at alternative sample locations in upper and lower Clear Creek, the Upper Sacramento River, Mill Creek, and Deer Creek through the 1999 spring emigration period. Nuclear microsatellite DNA analysis will be coordinated to follow immediately after sample acquisition for each of the various locations sampled. Data evaluation and project completion reports will be completed during calendar year 1999.

d. *Justification for Project and Funding by CALFED*

Steelhead are federally listed as a threatened species and are considered a 1st tier priority species by the CALFED Bay/Delta Program. Clear Creek is commonly viewed as providing excellent restoration potential in the Upper Sacramento River. A previous CALFED grant has been awarded to fund the removal of McCormick-Saeltzer dam, a steelhead migration barrier in Clear Creek. Removal of this dam will allow steelhead access to the only spawning and year-round rearing habitat in the tributary. Evidence suggests, however, that limitations of straying into the

newly-available habitat will prevent re-establishment of a viable population (low straying rate, "genetic bottleneck"). Information gained through this investigation will allow for an informed management decision to be made regarding the preferred (most similar to native Clear Creek steelhead) founding steelhead population in Clear Creek, facilitating timely re-establishment of a steelhead population in the tributary.

e. Budget Costs and Third Party Impacts

Project costs will be \$45,493 for the complete study design as proposed, and \$34,195 for the alternate (minimal) study design. There are expected to be no third party impacts.

f. Applicants Qualifications

Northern Central Valley Fish and Wildlife Office (NCVFWO) was established in 1978 as part of the U.S. Fish and Wildlife Service's responsibility to facilitate restoration of Pacific Salmonids. Specific goals of the NCVFWO are to: 1) stabilize or increase the runs of anadromous salmonids in the Sacramento River System; 2) improve the effectiveness of federal fish propagation facilities in California and Nevada; 3) protect and restore the productivity of natural habitats in the Sacramento River system; and, 4) continue development of information and strategies for protecting the natural habitats of the Sacramento River system as migration routes, spawning areas, and nursery areas for anadromous salmonids. The staff consists of 30 biologists and support personnel which have substantial experience working in the Upper Sacramento River and its' tributaries.

g. Monitoring and Data Evaluation

This proposal for research has no associated monitoring program. Peer review will be utilized in the study design, data evaluation, and reporting process.

h. Local Support/Coordination with Other Programs/Compatibility with CALFED Objectives

This proposed research is supported by the local watershed planning group, the Clear Creek Coordinated Resources Management Program, fisheries subcommittee. This research will benefit several current steelhead restoration planning documents including; *Anadromous Fish Restoration Plan*, *Central Valley Salmon and Steelhead Restoration and Enhancement Plan*, *Restoring Central Valley Streams: A Plan for Action*, *Steelhead Restoration and Management Plan for California*. This proposed research will complement with minimal redundancy current and proposed steelhead genetics research conducted by DFG and Dr. Nielsen.

**GENETIC COMPARISON OF STOCKS CONSIDERED FOR
RE-ESTABLISHING STEELHEAD *Oncorhynchus mykiss* IN CLEAR CREEK,
A TRIBUTARY TO THE UPPER SACRAMENTO RIVER**

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Northern Central Valley Fish and Wildlife Office
10950 Tyler Road, Red Bluff, California 96080
Phone: (530)527-3043
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Principle Investigators - Kevin Niemela and Matt Brown

Federal Agency - Tax Exempt

Participants / Collaborators - Dr. Jennifer Nielsen
USDA Forest Service, Hopkins Marine Station, Stanford University



IV. PROJECT DESCRIPTION

a. *Project Description and Approach*

The research proposed is designed to provide information on genetic diversity of several stocks of steelhead/rainbow trout *Oncorhynchus mykiss* from the Upper Sacramento River basin. Information gained through this research will be used primarily to determine the most appropriate founding-stock (most similar to native Clear Creek steelhead) for re-establishing a self-sustaining steelhead population in Clear Creek following the removal of McCormick-Saeltzer (Saeltzer) Dam, a barrier to migration. Results of this research will be used to facilitate rebuilding of a steelhead population in Clear Creek, while at the same time maintaining or improving the genetic integrity of the Upper Sacramento River steelhead population.

b. *Proposed Scope of Work*

Fifty tissue samples from steelhead/rainbow trout will be collected at Coleman NFH and each of several locations of the Upper Sacramento River and its' tributaries including: (1) Clear Creek above Whiskeytown Dam (one or two populations to be identified); (2) Clear Creek below Whiskeytown Dam; (3) Sacramento River at Redding; (4) Mill Creek; and, (5) Deer Creek. Sample locations above Whiskeytown Dam will be targeted at locating isolated, residualized populations of native *O. mykiss* and will be based upon known locations of self-sustaining rainbow trout populations, historical stocking records, and degree of geographical isolation from non-native *O. mykiss*. Fin tissue samples will be collected from spawned adult carcasses at Coleman NFH. Non-lethal caudal fin tissue samples (~1 mm²) will be collected from naturally produced juveniles and adults at the other locations by electrofishing, angling, beach seine, rotary screw trap, or carcass surveys. Tissues will be air-dried in the field and promptly sent to Dr. Jennifer Nielsen (USDA Forest Service, Hopkins Marine Station, Stanford University) for nuclear microsatellite DNA analysis. Microsatellite analysis is currently thought to be the best available tool for differentiating closely-related groups of organisms. Genetic distance measures will be used to evaluate relationships between groups by comparing microsatellite diversity within and between the seven sampled *O. mykiss* populations and several domesticated stocks of rainbow trout previously evaluated by Dr. Nielsen. Genetic associations between the sampled stocks will be used to determine the most appropriate founding source for rebuilding the steelhead population in Clear Creek.

c. *Location and/or Geographic Boundaries of Project*

Clear Creek, a tributary to the Upper Sacramento River, enters the mainstem Sacramento River at river kilometer 465 (river mile 289) near the city of Redding, Shasta County. The Clear Creek Ecological Unit lies within the North Sacramento Valley Ecological Zone as defined within ERPP.

d. *Expected Benefits*

The proposed research is intended to provide "fine-scale" information on genetic diversity among several stocks of steelhead/rainbow trout from the Upper Sacramento River basin. Information gained through this research will be used primarily to determine the most appropriate stock (i.e. most similar to native Clear Creek steelhead) for re-establishing a self-sustaining steelhead population in Clear Creek following the removal of Saeltzer Dam. This investigation will also benefit other steelhead restoration efforts throughout the Upper

Sacramento River basin (e.g. Anadromous Fish Restoration Program, Steelhead Restoration and Management Plan, Central Valley Salmon and Steelhead Restoration and Enhancement Plan) as knowledge is furthered on genetic diversity among existing steelhead stocks and genetically-conscious re-introduction methodologies. Working toward this end, the proposed study will provide the following secondary benefits for restoration of steelhead populations:

- identify fine-scale spatial groupings of genotypes that reflect the relationships between hatchery steelhead from Coleman NFH, non-anadromous strains of rainbow trout from California Department of Fish and Game (CDFG) hatcheries, self-sustaining natural steelhead populations in Deer and Mill Creeks, non-anadromous rainbow trout in upper and lower Clear Creek, and steelhead/rainbow trout in the Upper Sacramento River;
- indicate the utility of Coleman NFH steelhead for this and subsequent recovery efforts in the Upper Sacramento River;
- provide information on the extent of genetic introgression resulting from previous hatchery stocking of anadromous steelhead and resident rainbow trout in Clear Creek and the Upper Sacramento River;
- identification of isolated populations of residualized, "native" Central Valley steelhead located in areas of little previous hatchery stocking and contained above non-natural barriers to migration; and,
- provide information on temporal variability of existing, self-sustaining steelhead populations in tributaries to the Upper Sacramento River.

Stressors

This research will address several stressors which have been identified as causing deleterious affects to steelhead in the Central Valley. The proposed research will directly address stressors identified in the PSP: 1) population management stressors (PSP, Attachment C, No. 8, p. 78) related to both artificial propagation of fish and the associated genetic and management implications; 2) population management stressors (PSP, Attachment C, No. 8, p. 78) related to water management activities that have resulted in migratory pathway changes. Saeltzer Dam has blocked steelhead migration and will be removed soon. Re-establishment of steelhead will require a fine-scale genetic knowledge of the relationships between potential donor populations; and, 3) artificial propagation stressors (PSP, Attachment C, No. 10, p. 80) addressed in this research include genetic effects associated with previous propagation activities. Research will minimize genetic effects associated with future restoration activities.

e. Background and Biological / Technical Justification:

Anadromous fish populations of Clear Creek have been significantly depleted by the cumulative effects of water export, gold and gravel mining, timber harvest, road building, fish passage problems at McCormick-Saeltzer (Saeltzer) Dam, and migration blockage at Whiskeytown Dam. Restoration of Clear Creek habitat and anadromous fish populations is a focus of Federal, State, and local conservation efforts in the Upper Sacramento River. Through a multi-agency, cooperative approach considerable progress has been accomplished towards restoring and expanding anadromous fish habitat in Clear Creek. Completed and ongoing restoration activities include: cessation of instream gravel mining operations; increased flow releases from Whiskeytown Reservoir; addition of spawning gravel; erosion control; stream channel improvements; and, removal of Saeltzer Dam (planned for 1999).

The planned removal of Saeltzler Dam in 1999 provides a unique opportunity to re-establish a run of steelhead in a tributary of the Upper Sacramento River. Since its construction in 1903, Saeltzler Dam has impeded or blocked upstream migration of anadromous fish, including steelhead trout. As a consequence of this migrational barrier and other factors, steelhead have not been observed in Clear Creek since the 1960's when a single male carcass was found in the lower section below Saeltzler Dam (T. Healey, CDFG, Redding CA - personal communication). Removal of Saeltzler Dam will permit steelhead unobstructed access to an additional ten miles of Clear Creek, upstream to the base of Whiskeytown Dam. This section of Clear Creek provides the only accessible spawning and year-round rearing habitat for steelhead within the tributary, and one of few accessible, year-round steelhead rearing habitats remaining within any tributary of the entire Sacramento River drainage.

As a result of the forthcoming expansion of anadromous fish habitat in Clear Creek due to the planned removal of Saeltzler Dam, fishery biologists are given a unique opportunity to select the appropriate founding stock for rebuilding a self-sustaining steelhead population in the tributary. In order to make this determination, a genetic comparison of potential founding stocks is necessary. Genetic investigations have been utilized extensively to facilitate differentiation and recovery of endangered winter run chinook salmon in the Sacramento River. Similarly, genetic investigations are likely to play an important role towards restoration of native Central Valley steelhead populations.

Limited genetic research has been previously conducted on steelhead populations of the Upper Sacramento River. The recent designation of West Coast steelhead into fifteen Evolutionarily Significant Units (ESU's) relied heavily on genetic methodologies to differentiate stocks. In that study, National Marine Fisheries Service (NMFS 1996) used protein electrophoresis to compare genetic variability of *O. mykiss* collected from Mill Creek, Deer Creek, and Coleman NFH from the Upper Sacramento River to steelhead stocks from other locations of California and the West Coast. This study found the genome of fish from Coleman NFH and Mill and Deer Creeks to be relatively similar to each other and quite distinct from steelhead taken from other locations. This information provided the basis behind NMFS decision to include the hatchery stock from Coleman NFH within the Central Valley ESU. However, such "broad-scale" information (at the landscape level) on genetic groupings does not provide the resolution necessary for determining the best steelhead stock for rebuilding a steelhead population in Clear Creek. Steelhead genetic research conducted at other locations suggests significant genetic differentiation may exist between semi-isolated populations in adjacent tributaries to the Upper Sacramento River (Healey and Prince 1995, Parkinson 1984). Therefore, to determine the preferred steelhead founding stock for Clear Creek, a fine-scaled (at the population level) examination of the relationships between *O. mykiss* stocks of Coleman NFH, Clear Creek, and the Upper Sacramento River is necessary.

Directives from both the State and Federal level require genetic evaluations to be completed prior to conducting management activities aimed at steelhead reintroduction:

- According to California Department of Fish and Game (DFG) guidelines, streams are to be managed foremost for endemic fish originating in the same stream or tributary, however, reintroduction of steelhead may be warranted on some stream systems where the native stock has been extirpated (McKewan and Jackson, 1996). In those situations where reintroduction is deemed necessary, the donor stock used shall be the stock most genetically similar to the native stock (McKewan and Jackson, 1996). In instances where the native stock has been

extirpated from the lower, anadromous reach, it may be possible to initiate recovery of the endemic steelhead genotype through identification and translocation of residualized populations inhabiting the upper reaches of streams above non-natural barriers (McKewan and Jackson 1996). Therefore, "before introductions are implemented, genetic profiles of the (potential) donor stock(s) should be examined to estimate their relationship to the extirpated stock" (McKewan and Jackson 1996).

- National Marine Fisheries Service (NMFS) determined that Coleman NFH stock of steelhead belong within the Evolutionarily Significant Unit (ESU) of the Central Valley based on genetic evidence and information regarding broodstock histories. National Marine Fisheries Service, however, precluded the use of Coleman NFH steelhead for use in recovery efforts pending further (genetic) analysis. (Final Rule; Federal Register, Vol. 63, Number 53, NOAA, March 19, 1998).

With consideration of these guidelines and others set forth by NMFS and DFG, options considered for re-establishing a steelhead population in Clear Creek include: 1) allowing strays from the Upper Sacramento River to repopulate; 2) stocking steelhead (juveniles or returning adults) from Coleman National Fish Hatchery; and , 3) trans-locating offspring of "native", resident rainbow trout from isolated populations in upper Clear Creek, above Whiskeytown Dam. Each of these methods considered for re-establishing steelhead into Clear Creek are briefly discussed below along with information needs which will be addressed through this proposed research.

1) *allowing strays from the Upper Sacramento River to repopulate*

Evidence suggests that the natural rate of steelhead straying into Clear Creek will not be sufficient to re-establish a viable steelhead population in the tributary. Information regarding rates of steelhead straying into Clear Creek are limited, however, available evidence indicates a very low natural rate of infusion by mainstem spawners. The most recently documented observation of steelhead in Clear Creek was a single male adult observed by DFG personnel in the 1960's (T. Healey, CDFG, Redding CA - personal communication). Consequently, it appears likely that re-establishment of a self-sustaining steelhead population in restored sections of Clear Creek would not occur within a timely manner, and, considering the low rates of straying into Clear Creek, significant genetic concerns exist regarding the small effective population size for the Clear Creek steelhead founding population.

Additionally, it is not known what effects previous stocking practices have had on altering the genotype of anadromous steelhead and resident rainbow trout in the Upper Sacramento River. It appears likely that previous propagation programs have affected, to some degree, the genome of all steelhead in the system. Hatchery origin steelhead, including fish from several within- and between-basin transfers, have been stocked at various locations of the Upper Sacramento River including Clear Creek for over fifty years and hatchery steelhead currently comprise the vast majority of the Upper Sacramento River run. Furthermore, an unknown number of hatchery-origin adults stray from the hatchery on Battle Creek and spawn with the relatively small population of natural spawners in the Upper Sacramento River. Natural spawners from the mainstem Upper Sacramento River have not been genetically characterized so it is not known how they compare with either Coleman NFH stock, Mill or Deer Creek "native"

stocks, or resident rainbow trout from upper or lower Clear Creek. Therefore, re-establishing a steelhead population in Clear Creek through straying of Upper Sacramento River spawners does not resolve concerns associated with genetic origin of the founding stock.

2) stocking steelhead (juveniles or returning adults) from Coleman National Fish Hatchery;

Rebuilding of naturally spawning Upper Sacramento River steelhead populations may be accomplished most rapidly by utilizing hatchery produced steelhead from Coleman NFH. Hatchery steelhead from Coleman NFH have been precluded from use in recovery efforts, however, due to the unknown genetic association between that Coleman NFH steelhead and natural stocks in the Upper Sacramento River. Coleman NFH obtains its steelhead spawning stock mainly from returns to the hatchery on Battle Creek which was founded by adults from the Upper Sacramento River. Imports of other steelhead strains have occurred, however, including egg transplants from the American River (Brood Years {BY} 1972, 75, 76, 77, and 84), Mad River (BY 1978), and Feather River (BY 1989). Additionally, size selective breeding strategies have occurred at Coleman NFH sporadically for almost fifty years and exclusively since the mid-1980's. Genetic effects of these propagation practices have not been investigated. Recent allozyme analysis (NOAA, NMFS, Status Review of West Coast Steelhead) do not provide the resolution necessary to detect "fine-scale" differences resulting from these propagation practices. Therefore, NMFS has precluded the use of steelhead from Coleman NFH in restoration activities pending further analyses. Knowledge of the genetic associations between Coleman NFH and natural spawning stocks in the Upper Sacramento River basin is necessary to determine the utility of that hatchery stock in this and future recovery efforts.

3) trans-locating offspring of "native", resident rainbow trout from isolated populations in upper Clear Creek, above Whiskeytown Dam;

Recent studies have shown that isolated, residualized populations of *O. mykiss* occurring above non-natural migrational barriers may maintain some of the unique molecular signatures found in the anadromous founding stock (Nielsen et al. 1997). Therefore, a currently proposed methodology for reintroduction of "native" anadromous steelhead calls for transferring offspring of residualized *O. mykiss* (resident rainbow trout) from above non-natural barriers into anadromous waters with the expectation that a proportion of the progeny would take on the anadromous (steelhead) life-history type (Dennis McKewan, DFG, Sacramento - personal communication). The present research proposal is intended to complement a concurrent proposal submitted by DFG through the Sport Fish Restoration Fund to evaluate this re-introduction technique (D. McKewan, CDFG Sacramento, personal communication). The DFG proposal, however, differs from the current proposal in that it (the DFG proposal) focuses primarily on a more-thorough evaluation of this one re-introduction strategy, whereas the current proposal evaluates genetic concerns associated with three different re-introduction techniques.

Genetic questions regarding this proposed reintroduction technique center around the uncertain influence of genetic factors in determining life-history type (anadromous vs. resident) in *O. mykiss* and also the unknown effects of previous stocking practices on indigenous rainbow trout in tributaries to the Upper Sacramento River. Previous research has shown that environmental factors do impart influences upon the life-history type "selected" by juvenile *O. mykiss*, however, it has not been determined to what extent heritable, genetic traits influence the tendency for anadromy within individuals of the species (research proposed by CDFG will evaluate this aspect). Additionally, it is not known whether "native" populations *O. mykiss* exist

anywhere within the Clear Creek watershed. Catchable sized rainbow trout have been regularly planted at various locations of upper Clear Creek since at least the early 1930's. Hatchery rainbow utilized in these plants were typically obtained from state hatcheries at Darrah Springs, Crystal Springs, and Mt. Shasta and may include several different hatchery strains of rainbow trout. Furthermore, from 1964 - 1978 Coleman NFH planted up to 85,000 resident rainbow trout annually into Whiskeytown Reservoir. These fish contained representatives of non-anadromous rainbow trout stocks originating from hatcheries in Montana and Washington as well as kamloops trout (Gerrard strain rainbow trout) originating in Oregon, Idaho, and British Columbia. Post-stocking survival, distribution, and eventual spawning contribution of these planted, non-native fish is unknown. Likewise, effects these stocking practices on altering the genome of "native" *O. mykiss* in upper Clear Creek must be determined before this method of steelhead recovery is implemented.

Ecosystem Restoration Program Plan (ERPP) Objectives

This proposed research will directly address several implementation objectives identified in the Programmatic EIS/EIR Ecosystem Restoration Program Plan (ERPP). The implementation objective for steelhead trout is to "ensure the recovery of this species... to a sufficient population size to support inland recreational fishing and fully use existing and restored habitat areas..." (ERPP, Volume II, Sacramento River Ecological Zone section, steelhead subsection, p. 190). Furthermore, a short-term target for restoring steelhead populations identified in the same section is to "support the management and restoration of each stock to maintain the adult population at a ratio much greater than 1.0 while the individual stocks are rebuilding to desired levels." This research presented in this proposal will provide information to facilitate accomplishing both the implementation objective and target for steelhead, a CALFED 1st Tier priority species.

This research also addresses an artificial fish propagation implementation objective for the Sacramento River Ecological Zone which is to "reduce the potentially adverse effects of stocking artificially produced fish throughout Central Valley Streams and Rivers (in order to)... contribute to long-term restoration goals and maintain the genetic diversity of naturally producing populations of chinook salmon and steelhead" (ERPP, Volume II, Sacramento River Ecological Zone section, Artificial Fish Propagation subsection, p. 156). Additionally, this research directly addresses Target 2 and Programmatic Action 2A identified in the same section which deal with artificially rebuilding naturally spawning populations when alternative measures are deemed insufficient to provide recovery.

f. Monitoring and Data Evaluation

This proposal for research has no associated monitoring program. Peer review will be utilized in the study design, data evaluation, and reporting processes. This research is supported by the local watershed planning group, the Clear Creek Coordinated Resources Management Program, fisheries subcommittee. This research will benefit several current steelhead restoration planning documents including; *Anadromous Fish Restoration Plan*, *Central Valley Salmon and Steelhead Restoration and Enhancement Plan*, *Restoring Central Valley Streams: A Plan for Action*, *Steelhead Restoration and Management Plan for California*. This proposed research will complement with minimal redundancy current and proposed steelhead genetics research conducted by DFG and Dr. Nielsen.

g. Implementability

The service will obtain the required sample collection permits to allow the directed take of steelhead for research purposes.

References

- Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagorarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum MNFS-NWFSC-27
- Healey, M.C. and A. Prince. 1995. Scales of variation in life history tactics of Pacific Salmon and the conservation of phenotype and genotype. Pages 176-184 in J.L. Nielsen and D.A. Powers ed. *Evolution and the Aquatic Ecosystem: Defining Unique Units in Population Conservation* American Fisheries Society Symposium, 17:8-27.
- McEwan, Dennis, and Terry A. Jackson. 1996. Steelhead Restoration and Management Plan for California. The Resource Agency, State of California, Department of Fish and Game. 234 pp.
- Nielsen, J.L., C. Carpanzano, M.C. Fountain, and C.A. Gan. 1997. Mitochondrial DNA and nuclear microsatellite diversity in hatchery and wild *Oncorhynchus mykiss* from freshwater habitats in southern California. *Trans. Am. Fish. Soc.* 126:397-417.
- Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley Streams: A Plan for Action. California Department of Fish and Game, Inland Fisheries Division.
- Reynolds, F.L., R.L. Reavis, and J. Schuler. 1990. Central Valley Salmon and Steelhead Restoration and Enhancement Plan. The Resources Agency, State of California, Department of Fish and Game. 115 pp.
- Parkinson, Eric A. 1984. Genetic variation in populations of steelhead trout (*Salmo gairdneri*) in British Columbia. *Can. J. Fish. Aquat. Sci.* 41:1412-1420

V. COSTS AND SCHEDULE TO IMPLEMENT PROPOSED PROJECT

a. Budgeted Costs

This project may be completed in two phases, if necessary, to minimize expense. For the complete study design as proposed, annual project costs in 1999 will be \$45,493. An alternate study design would eliminate tissue collections from native steelhead populations in Mill and Deer Creeks, thereby failing to obtain valuable information regarding temporal stability of Upper Sacramento River Steelhead stocks, however, still completing the major aspects of the study at a lesser expense. Annual project costs for this alternative (minimal) study design are \$34,195 (Table 1.) This project will utilize existing equipment, such as boats, electroshocker, and vehicles. Alternative funding sources for this project have not been secured.

Under this research proposal, genetic analyses are to be subcontracted through Dr. Jennifer Nielsen and these services will not be put up to bid. Retaining Dr. Nielsen for this investigation is critical to the success of this research program as much of what we propose to evaluate is based on previous, current, and proposed investigations of steelhead genetics conducted through her laboratory.

Table 1. Proposed budget to complete identified tasks associated with complete and alternative designs of Clear Creek steelhead genetic investigation.

Project Phase	Direct Labor Hours	Direct Salary and Benefits	Overhead Labor (Admin.)	Service Contract	Material and Acquisition Contracts	Misc. and other Direct Costs	Total Costs
Complete Study Design	978	\$19,274	\$4,240	\$20,313	\$0	\$1,665	\$45,493
Alternative Study Design	770	\$15,659	\$3,445	\$13,542	\$0	\$1,549	\$34,195

b. Scheduled Milestones

Field work for this program will begin with collection of tissue samples from steelhead returns to Coleman National Fish Hatchery in January, 1999. Tissues will be collected from naturally spawning steelhead/rainbow trout adults and juveniles captured at alternative sample locations through the 1999 spring emigration period. Genetic analysis will be coordinated to follow immediately after sample acquisition. Data evaluation and project completion reports will be completed during calendar year 1999.

c. Third Party Impacts -- None

VI. APPLICANT QUALIFICATIONS

Northern Central Valley Fish and Wildlife Office (NCVFWO) was established in 1978 as part of the U.S. Fish and Wildlife Service's responsibility to facilitate restoration of Pacific Salmonids. Specific goals of the NCVFWO are to: 1) stabilize or increase the runs of anadromous salmonids in the Sacramento River System; 2) Improve the effectiveness of federal fish propagation facilities in California and Nevada; 3) protect and restore the productivity of natural habitats in the Sacramento River system; and, 4) continue development of information and strategies for protecting the natural habitats of the Sacramento River system as migration routes, spawning areas, and nursery areas for anadromous salmonids. The staff consists of 30 biologists and support personnel which have substantial experience working in the Upper Sacramento River.

Key Project Personnel and Qualifications

James G. Smith.-- Mr Smith is the project leader at the U.S. Fish and Wildlife Service's Northern Central Valley Fish and Wildlife Office where he is responsible for the management of a staff of 30 persons. Mr. Smith received a B.S. degree with a major in fishery biology from Humboldt State University in 1975 and did post-graduate studies at the same from 1976-79. He

has worked as a professional biologist for 18 years in Oregon, Washington, and California. Mr. Smith works on a daily basis with numerous federal, state, and private entities in developing actions and programs for restoring, conserving, and enhancing anadromous salmonids in the Upper Sacramento River.

Matt Brown. - Mr. Brown received a Bachelors of Arts Degree in Biology from the University of California at Santa Cruz in 1986 and a Master of Science Degree from Arizona State University in 1990. He worked as a non-game fish biologist for the Arizona Game and Fish Department from 1990 to 1991. He worked for the Fish and Wildlife Service on threatened and endangered fish in New Mexico from 1991 to 1993. Matt began work on chinook salmon at the Northern Central Valley Fish and Wildlife Office in January 1994. His current work focuses on habitat restoration under the Central Valley Project Improvement Act and evaluating the impacts of water development. Mr. Brown is the Fish and Wildlife Service lead for Clear Creek restoration.

Kevin S. Niemela. - Mr. Niemela is a 1992 graduate from University of Minnesota (B.S., Fisheries and Wildlife) and a 1995 graduate from University of Idaho (M.S., Fisheries Resources). While pursuing his Masters degree, Mr. Niemela worked for the Idaho Cooperative Fish and Wildlife Research Unit and the Office of Naval Research evaluating effects of U.S. Navy acoustical testing on salmonids in Lake Pend O'reille, Idaho. Mr. Niemela has been with the U.S. Fish and Wildlife Service for 3 years and is currently a fisheries biologist working on steelhead and evaluations of Coleman National Fish Hatchery.

Dr. Jennifer Nielsen. - Ms. Nielsen is a 1987 graduate from The Evergreen State College (B.S.), a 1990 graduate from the University of California at Berkeley (M.S.), and a 1994 Doctoral graduate in Wildland Resource Science from the University of California at Berkeley. Dr. Nielsen's dissertation was entitled "Molecular Genetics and Stock Identification in Pacific Salmon (*Oncorhynchus* spp.)." Ms. Nielsen's current research focuses on steelhead genetics, working as a research geneticist with U.S. Forest Service and Hopkins Marine Station. She also serves as an adjunct professor at Stanford University. Ms. Nielsen has authored several peer review articles on steelhead genetics and is commonly viewed as an authority in this area of research.

VII. COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

We will provide appropriate documents and signatures regarding Submittal/Compliance of Standard Terms and Conditions prior to signing final contracts, as indicated in Table D-1 matrix of Standard Clauses/Proposal Request for a public agency proposing a Group 3 (Services) application type.